

REPORT TO IHRA STEERING GROUP - MAY 2002

Peter O'Reilly
DETR (UK), Chairman of IHRA
Vehicle Compatibility and Frontal
Impact WG

WG Aims

- Improve occupant protection by developing internationally agreed test procedures to improve the compatibility of car structures in front to front and front to side impacts
 - Secondary aim to consider protection in impacts with pedestrians, heavy goods vehicles and other obstacles
 - New draft TOR to reflect frontal impact

Participants

- Scientific members representing governments in Europe, USA, Japan, Australia and Canada
- Representatives of industry in USA, Japan and Europe
- Many have own programmes or resources e.g. USA, Japan, Australia, Europe (EEVC, national, EUCAR)
- Front membership still settling in

WG - Activities

- First Compatibility WG meeting June 1997
- Three meetings since ESV2001
- EEVC and Australian research links in these
- Reports to GRSP (frontal and compatibility)
- Workshop planned
- Current focus has continued to be on compatibility
- Links with other research programmes

Work plan

- Problem definition
- Determine key characteristics
- Assessment methods

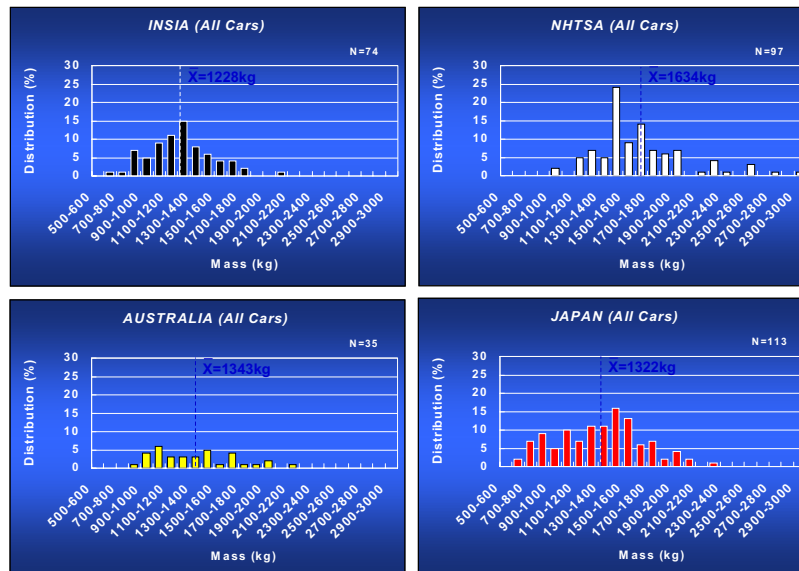
Research Approaches

- Analyses - fleet, accident and structural
- Vehicle to vehicle crash tests -front and side
- Vehicle to Barrier tests (fixed barrier)
- Vehicle to barrier (load cell wall)
- Vehicle to MDB
- Overload/compartment strength testing
- Models FE and MADYMO
- Fleet model

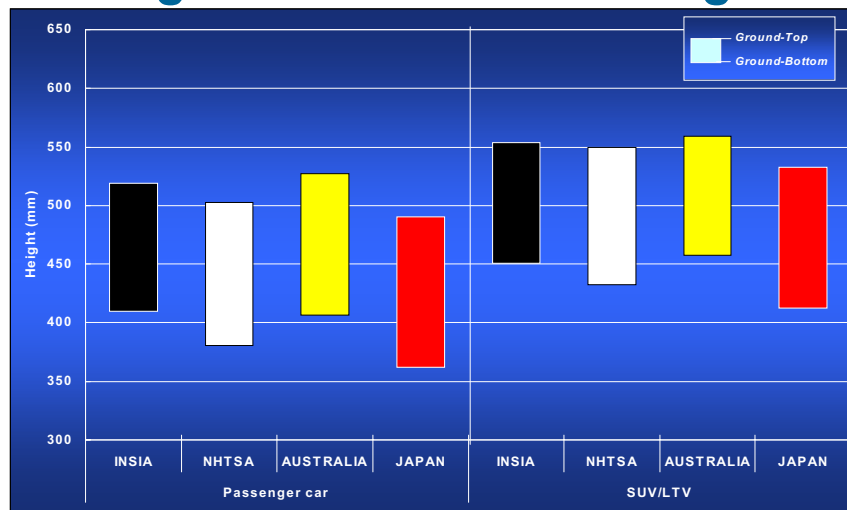
Fleet Composition

- LTV/SUVs
 - USA, Canada high presence and rising
 - Australia intermediate
 - Europe and Japan low
- Mass (broad sources)
 - Midsize US car group 1360-1590kg (+400kg LTV)
 - Japan/Europe 1150/1200kg
- Overview of regional car measurement surveys
 - structural members have similar dimensions
 - US models +300kg
 - some more data needed

Mass Distributions of Investigated Car Models



Average Dimensions of Longitudinal Member Heights



Accident Analysis

- Broad national data
 - mass but other effects may be present and not disentangled
 - LTVs relatively more aggressive - geometry and stiffness
- More detailed data
 - Examples of poor compatibility often found
 - Intrusion significant injury factor
- Research to continue (including in-depth)
- Will help support later cost benefit estimates

Vehicle testing (front)

- Examples of poor interaction, in particular over-riding; inefficient use of energy absorbing structure
- Better frontal connections help
- Link injury criteria in struck vehicle and aggressivity metric of striking vehicle

Broad position

- Compatibility not “simply mass”
- Geometry and stiffness are at work
- Examples of poor structural interaction often found
- Intrusion - fatal and serious injuries

Barrier (fixed) testing

- Full width barrier with load cells - hypothesis: good homogeneity will lead to improved structural interaction
- OBD load cell data
- Interpretation of data: potential criteria AHOF, analysis of variations, others, footprint
- Shear - Progressive Deformable Barrier PDB, two approaches constant speed, constant energy

MDB testing

- NHTSA: allows best overall coverage of US accidents - desire to include frontal crash protection and compatibility
 - not fundamentally opposed to fixed barrier if equivalent protection
- Some issues/concerns: over-riding, repeatability, configurations

Overload/compartment strength tests

- Severe test aimed only at assessing passenger compartment strength
- Two avenues explored
 - using previously impacted car
 - results unrealistic
 - using new car
 - severe test; no or minimal criteria
 - failure modes, repeatability
 - evidence at lower speed?

Relevant aspects - frontal

- Good structural interaction
- Maintain passenger compartment integrity
- Predictable performance of structure
- Control deceleration time histories

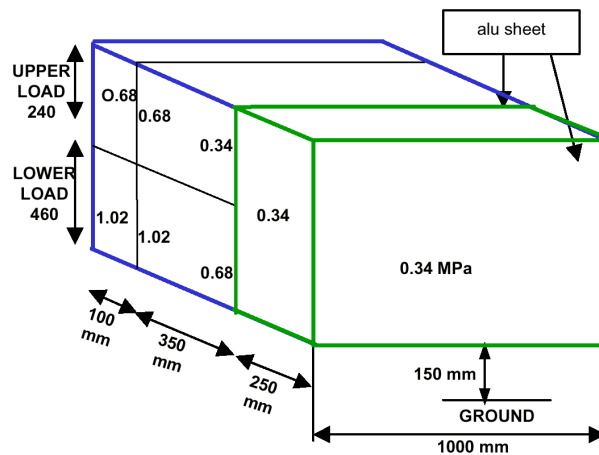
Possible Front Test Procedures

- Full width frontal barrier with load cells (with or without deformable element?)
- Offset Deformable Barrier ODB with load cells
- Overload/compartments strength test ODB (compartment integrity)
- Barrier elements to explore shear PDB (two approaches (constant speed, constant energy))
- Mobile deformable barrier (various)

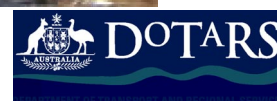
Full Deformable Barrier



Progressive Deformable Barrier



PDB Testina



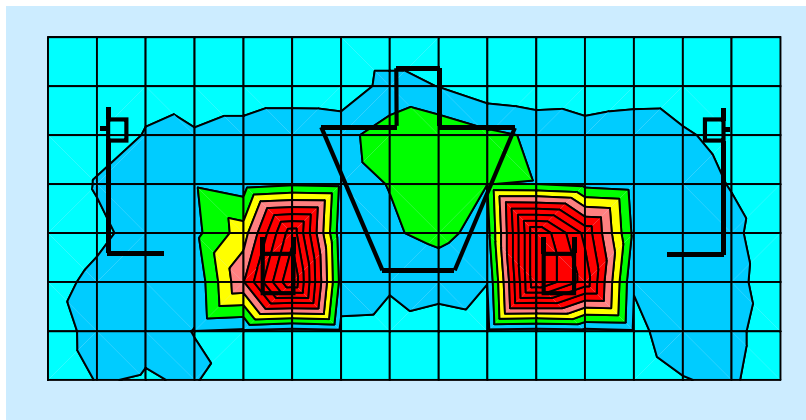
Average Height of Force

Compute the effective height of the applied force on the barrier face

$$\text{Average Height} = \frac{\sum_{i=1}^N F_i H_i}{\sum_{i=1}^N F_i}$$

Load cell peak forces for an SUV.

Note, vehicle main structure is superimposed on plots to show load paths.

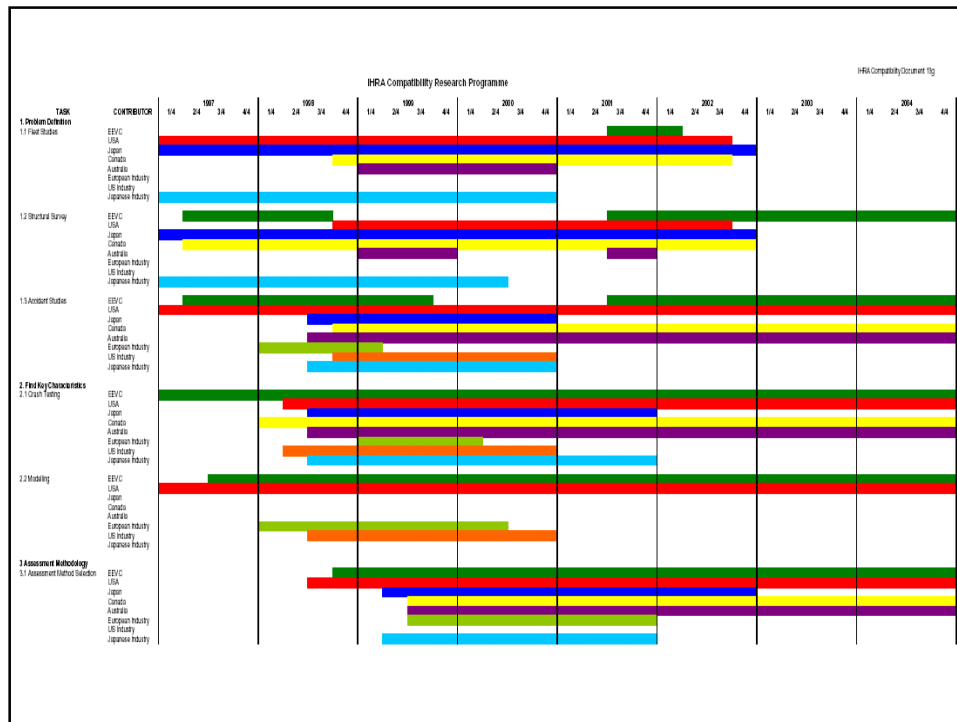


Focus on frontal compatibility tests

- Nothing ruled out
- Appreciable effort being made on development of test approaches
- Interpretation of results

Possible Side Test Procedures

- Side remains complex
- Frontal proposals that encourage homogeneity and good interaction with sill/ side pillars likely to help
- Key elements affecting aggressivity known
 - geometry greatest
 - vertical intrusion profile
 - stiffness distribution of bullet vehicle (initial)
 - promoting sill engagement
 - distributed loading of occupant
- Currently difficult to define envelope of desirable vehicle (front) characteristics (first 100mm?)



Issues (Research/ technical)

- Unified approach required for benefits
- Improving understanding/ interpretation of test data for good structural interaction
- Deviations from existing frontal test(s)?
- Choice of procedure(s)
- Define outline and detail of test procedures and key criteria (research, then evaluation)
- Definition of an MDB test, if it were to be an international approach
- Mechanisms to support choice(s)
- Progress very dependent on continued research
- Others

More General Issues

- Effective forum - early interaction
- Rely on research work of Members
- Different regional emphases and phasing but much in common
- Focus on technical/ fleet aspects
- Emphasis on key elements and increasingly on potential test procedures
- Industry involvement has been healthy

Other

- NHTSA potential rule making - reduced time frame
- Workshops
- Data compilation/overviews
- Website

To Conclude

- Test procedures achievable for front, side some way off
- Improved front structural interaction beneficial in itself and a pre-requisite
- Range of tests are candidates - choice
- Compatibility issues can arise in all impacts
- US rule making - opportunity or challenge
- Staged approach is possible

THANK YOU

Co-operation and contributions
from all in IHRA group are
gratefully acknowledged.